PEACOCK, KENNETH EDWARD

MUNICIPAL BOND RATINGS: A MULTIPLE DISCRIMINANT ANALYSIS

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MUNICIPAL BOND RATINGS:
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Kenneth Edward Peacock
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ABSTRACT

Several studies attempting to predict the bond rating of a corporate entity have been conducted in recent years. Although these studies have had limited success in predicting the actual bond rating, the results have raised some interesting and thought-provoking questions within the accounting profession.

The purpose of this study was to analyze the bond rating procedures and the factors, quantitative and qualitative, that are most likely considered in rating a general obligation bond issue of a municipality. An attempt was then made to develop a statistical model based on selected quantitative factors that would duplicate the ratings of one major rating service, Moody's.

The ten quantitative factors selected for analysis in the study were: (1) average debt per capita; (2) average full faith and credit debt per capita; (3) average revenue per capita; (4) average percentage of federal and state aid to total revenue; (5) average percentage of long-term debt retired to long-term debt issued; (6) average percentage of total debt to assessed value of property; (7) average percentage of total debt to estimated market value of property; (8) average percentage of uncollected taxes; (9) average percentage of welfare payments to total revenue; and (10) average percentage of property taxes to total taxes. With each ratio, the average is for the two most recent financial reporting

periods prior to the rating of the municipal bond issue.

The data base consisted of most general obligation bond issues by municipalities with a population of 50,000 or more and with a rating in one of Moody's top four rating classes, beginning in 1976 through 1978. Since the quantitative factors cover the two immediate years prior to the rating, the ratio data covered the time period 1974 through 1977.

Using the financial ratio data for the 152 municipal bond issues in the sample for the years 1976 and 1977, multiple discriminant analysis was used to derive the linear combination of the quantitative factors that best discriminated among the bond rating classes. The functions which resulted were used to attempt to predict the actual rating of the bonds issued in 1978. Of the ten variables included in the study, only two, the average percentage of long-term debt retired to long-term debt issued and average full faith and credit debt per capita, were determined to possess little discriminatory power among the various rating classes and were not included in the model for prediction of the 1978 bond issues. The three variables which contributed most to the discriminatory ability of the model were (1) percent of debt to market value of property; (2) debt per capita; and (3) percent of property tax to total taxes.

When the functions derived were applied to the 43 municipal bond issues in 1978, the bond rating was predicted with 67.44 percent accuracy. Within one rating class, the 1978 bond issues

were predicted with 93 percent accuracy. This prediction accuracy indicates that accounting data in evaluating the credit worthiness of a municipality is useful.

In addition, the results of this study suggested three additional possibilities. First, there may be an increasing emphasis on quantitative factors in rating municipal bonds. Second, there may be additional quantitative factors which municipal finance officers should consider when attempting to upgrade the rating of their city's bonds. Third, disclosure of certain of the variables considered in this study may be useful to readers of municipal government annual reports.

Although the results of this study indicated some interesting points, exact duplication of Moody's bond ratings was not obtained. Future experimentation with more variables and with non-linear discriminant functions may improve the predictability.

CHAPTER I

INTRODUCTION

States and their political subdivisions--cities, counties, school districts, and special authorities--borrow money in the municipal bond market. This market is utilized both by New York City, when it wants to borrow $300 million, and by Pelican Rapids, when it wants to borrow $58,000. With total transactions of more than $50 billion each year, representing the borrowing of several thousand governments, this capital market is extremely large and diverse.

Unlike an exchange for listed securities, the municipal bond market is not confined to a single location. Rather, it is a nationwide network of investors, investment institutions, securities dealers, and governmental borrowers. In this setting, thousands of municipal securities are traded each business day. Each security is different, ranging from long-term bonds secured by diverse revenues of New York to three-month notes payable from subsidies guaranteed by the federal government. Since the investor is unable to evaluate the creditworthiness of each of the thousands of issues traded daily, a system of bond ratings has been developed.

Municipal bond ratings play an important role in this market.

They substantially affect how much it costs these governmental units to borrow. The weight which is given to ratings is illustrated by two specific cases.

On September 22, 1973 the Director of the Department of Budget and Financial Management for Fairfax County, Virginia elatedly announced that the Moody's rating of the forthcoming general obligation bond issue had been raised from A to Aa. The Director estimated that this upgrading of the rating should reduce the interest rate from about 5.35 percent to about 5.20 percent, saving the county more than $400,000 in interest over the 20-year term of the $32 million bond issue.[1]

Conversely, the Director of Finance for New York City stated before the Subcommittee on Economic Progress of the Joint Economic Committee that Moody's downgrading of New York's bonds in July, 1965 would result in extra interest cost of $2.5 million per year on each new bond issue. With the average life of recent issues approximating eight years, this would result in total extra interest cost per year of $20 million.[2]

With such power to influence the operation of the marketplace, questions regarding these ratings are certain to arise, especially when the power to rate resides in the hands of two private firms.

What is a Rating?

A bond rating is a judgment about the investment quality of

a securities issue. Currently, there are two nationally recognized companies--Moody's Investors Service, Inc. and Standard & Poor's Corporation--which assign ratings to state and local bond issues. Moody's, the older of the two agencies (founded in 1909), issues many more government bond ratings than Standard & Poor's. In recent years 60 percent of the dollar volume of bonds receiving ratings were graded by both companies, 35 percent were rated only by Moody's and 5 percent only by Standard & Poor's. Large issues are usually rated by both agencies. The alphabetical symbols which represent the investment quality or creditworthiness of the bonds used by these two companies are defined in Table 1. Those bonds in the A and Baa groups, which Moody's believes possess the strongest investment attributes, are designated by the symbols A-1 and Baa-1. A more detailed explanation of Moody's bond ratings is in the exhibit.

Simplified Definitions of Rating Categories — Table 1

Quality Characterization	Symbols: Moody's	Symbols: Standard & Poor's
Prime	Aaa	AAA
Excellent	Aa	AA
Upper Medium	A, A-1	A
Lower Medium	Baa, Baa-1	BBB
Marginally Speculative	Ba	BB
Very Speculative	B, Caa	B
Default	Ca	D

For all practical purposes, only the first five rating cate-

gories are used by the agencies and the lowest of the five (Ba and BB) may be on its way out. Small entitites that might be rated Ba or BB could, after comparing interest rates decide that it would be better off to proceed without a rating than pay the rating fee and receive the low rating.

What is Credit Risk?

The bond rating system attempts to separate municipal bond issues into classes of relative credit quality. The term "credit quality" connotes the relative degree to which credit risk is present in a particular bond issue. There appears to be some confusion in the literature as to the meaning of this term "credit risk."

The first impression is that the ratings are an expression of the risk of default. The rating agencies have said that although this default risk is the heart of the matter, they demur from exclusive reliance on that risk as the determinant of credit quality.[4] The sophisticated providers and users of ratings--the bond raters themselves and large institutional investors--know that default risk is but one component of relative bond quality. Although the ultimate credit risk is default, the rating agencies suggest a better definition. "Credit risk is the risk of future credit developments adverse to the interest of the creditor. This definition includes, but is not limited to, the risk of default and encompasses the broader spectrum of credit risk

potentially inimicable to the interest of the bondholders that are interested in the term 'credit quality.'"[5]

Therefore, the definition includes not only the risks involved in timely payment of principal and interest, but also the ability of the investor to sell the bond at a relatively good market price prior to maturity. The credit rating is thereby linked to the anticipated future performance of the bond in the secondary market.

Increase in Ratings of Bond Issues

Not all bonds are rated. Until a few years ago, both agencies routinely rated bonds without a charge to the government selling them. The raters were compensated by selling financial manuals containing the ratings to potential investors and security dealers. In the late 1960's, the agencies changed their policies and would rate a new issue only for a fee.

Even with the fee, the volume and number of bond issues rated has increased. In the late 1950's and early 1960's, approximately 75 percent of the new issues were rated; in the early to mid 1970's, approximately 90 percent of the new issues were rated. In terms of dollars, the percentage of new bond issues which are rated has increased from approximately 40 percent to 70 percent over the past fifteen years.

Over this period, the size of the average bond issue of municipalities has increased substantially. This growth largely

accounts for the increased percentage of rated bonds. As shown in Table 2, the larger the issue, the more likely it is to be rated. More recent estimates indicate that approximately 94 percent of new municipal bond issues of $5 million in size or larger were rated, but only 41 percent of those $250,000 or smaller were rated.

Percentage of New Issue Municipal Bonds Rated by Size of Issue — Table 2

Size of Issue (in thousands)	Dollar Volume	Number of Issues
Below 250	43.5	41.0
250-500	58.6	57.6
501-1,000	67.4	65.7
1,000-5,000	88.7	87.2
5,000-20,000	91.5	90.6
20,000 and up	90.6	90.8

Source: Moody's Municipal Bond Guide

Criticisms of the Current Rating System

Bond ratings are used by those engaged in trading, underwriting, and investing in municipal bonds. The increase in the number of municipal bond issues coupled with the recognized substantial influence which these ratings exert on the cost of capital to governmental entities has resulted in widespread criticisms of the current rating system from various governmental fiscal officers as well as the users of the bond ratings. Basically, the literature reveals three principal criticisms of the present ratings.

The most frequent complaint of these ratings is the lack of clarity about what ratings actually measure. While ratings are intended to gauge the relative degrees of credit quality, and the component factors believed important have been listed on various occasions, how such factors are weighted and why they are weighted in determining the assigned rating remains unclear. What precisely constitutes a good versus a better degree of creditworthiness is seldom spelled out. One municipal finance officer in testimony before a congressional subcommittee stated that many local governments are being robbed annually because their bonds were issued at lower than realistic ratings. "A double-barreled financial threat confronts the municipalities of our great nation," stated Roy Goodman, Finance Director of New York City. Later he stated, "I have become convinced that it (i.e., the private municipal credit-rating system) is causing leading cities to be shortchanged out of hundreds of millions of dollars in unwarranted interest charges vitally needed for basic services."[6]

Another frequently voiced criticism of the rating system concerns the number of rating categories. Some believe that four active investment ratings are not sufficient to reflect refinements in quality. Others argue just the opposite, contending that investment grade bonds are becoming similar in quality so that fewer categories are needed.

The third principal criticism is that the coverage is too narrow. That is, too many issues are not rated. Investigations of the Subcommittee on Economic Progress of the Joint Economic Committee revealed that approximately 40 percent of the new bonds, approximately 1500 issues, enter the market without a credit rating.[7] These bonds are typically small issues primarily oriented to a local market, although some large issues are also unrated for a variety of reasons.

Recommendations for Improvements in the Rating System

Even though the criticisms of the current rating system continue, all groups involved in the municipal market have had no choice but to continue to rely on the services of a limited number of private rating agencies for evaluations of the relative credit quality of a borrowing unit. In 1974, the Trustees of the Twentieth Century Fund decided that this continued and widespread criticism, coupled with continued reliance on the rating agencies, warranted examination. The Trustees felt that the availability of capital and its costs are of concern not only "to dealers in municipal obligations, or to politicians who represent the local government, or to lenders, institutional and individual, but, above all, to taxpayers who must bear the burden of servicing the debts of the communities in which they live."[8]

In arriving at its conclusions and recommendations, the

thirteen member Task Force deliberated at length on the nature and influence of municipal bond ratings. Two primary recommendations made by the Task Force to the rating agencies were as follows:

1. An Explicit Statement of the Rating Criteria.

   The Task Force believed that there is already an implicit norm, a standard of criteria that demarcates the classes of credit quality. Unfortunately, that standard is not generally known. The rating agencies should fully disclose the criteria used in reaching their appraisals, including the specific factors that enter into ratings and the weight they are given in assigning a rating.

2. An Explicit Statement of What Ratings Measure.

   "Why" certain factors are believed to be important in judging credit quality is fundamental to the decision of "which" factors should be used in assigning a rating. Without a reasoned statement of the nature of the risk being measured, it is impossible to know the significance of a rating or to judge its accuracy. The Task Force thus recommended that the rating agencies fully disclose and be much more explicit about what they are measuring in the assignment of credit ratings.

The recommendations of the Twentieth Century Fund Task Force made in 1974 have been virtually ignored by the rating agencies.

Criticisms continue. The attitude of Albert C. Esokait, senior vice-president of Moody's, is that these recommendations can not be fulfilled. Mr. Esokait stated that bond rating ". . . is not a numbers game. You couldn't rate bonds on a computer. It would blow a gasket. Bond rating is a comprehensive analysis of the position of an entity. . ."[9]

Purpose of Study

The purpose of this study is to analyze the rating procedure and what factors, quantitative and qualitative, are most likely considered in rating a general obligation bond issue of a municipality. An attempt will then be made to develop a statistical scoring system based on selected quantitative, accounting type factors that would duplicate the ratings of one major rating service, Moody's.

If such a statistical model were available, municipalities could predict their rating. By being able to determine their interest cost from a bond issue, municipalities could better evaluate whether to raise funds by a bond issue or by other means. Such a scoring system could be applied to unrated bonds so as to estimate the rating that would most likely have been assigned by the rating agencies. Investors and regulatory bodies could then evaluate both rated and unrated bonds in an internally consistent fashion. Furthermore, a model based on readily available accounting-type factors may enable investors to predict whether a bond

issue is to have a ratings change. As structured, this study does not test for the prediction of a ratings change; however, this study is a logical starting point for such a test in the future.

CHAPTER II

THE RATING PROCEDURE AND LITERATURE REVIEW

The first municipal bond issue was rated by Moody's in 1919. The rating procedure and the criteria used in reaching a conclusion as to the rating were quite simple--the number of railroads passing through the town. One railroad called for a single A, two for Aa, and so forth. This rule of thumb continued until the great depression. Large numbers of defaults during the 1930's caused Moody's to reevaluate its standards.

Some municipal finance officers feel that the standards, procedures and factors considered in recent years are as outdated as basing the rating on the number of railroads passing through the city. Abraham Beame, while serving as city controller of New York, stated that the services of the rating agencies were "unfair, capricious and arbitrary." Other municipal finance officers feel that the art of municipal bond analysis has come a long way since the predepression days. Ralph G. Casco, finance officer of Nassau County, New York, stated that bond ratings were the work of "financial wizards, men who studied long and carefully" and "who do not just listen to what is said, but look at facts and figures."[10]

The Rating Procedure

Work on a rating is begun when the rating agencies learn of an issue, usually through The Daily Bond Buyer. For a rating to be published, an agency must receive a contract from the municipality and pay the fee. Once the contract is received, the agency may send a set of questionnaires to the issuer. Annual budgets and financial reports, bond ordinances and contracts are also studied.

After the agency receives all the required data, a staff of researchers examines the data for accuracy and completeness, checks it against trends, and then transfers it to a worksheet for an analyst's evaluation. The staff of analysts is assigned responsibility for geographic areas, each having responsibility for an average of four states. The analyst begins the evaluation, consisting of correlations and comparisons of data and reviews of nonquantitative factors. His work may also include both direct contact with the issuer in order to get further information and periodic trips to his assigned territory.

After the analyst has reached a recommended rating, he makes a presentation to a rating committee consisting of senior analysts. The committee reviews the analyst's recommendation, discussing the various objective and subjective factors. If they feel satisfied that sufficient data are available to reach a conclusion, the committee will assign a rating which reflects a compromise

of various points of view.

The final procedural step is to notify the municipality of its rating. Unless the issuer takes exception to the rating, it is released to all inquiring parties and is published a week before the bond sale in both agncies' publications and The Daily Bond Buyer.

Most municipalities keep the agencies supplied with the necessary data; thus, most ratings are fairly routine. General obligation issues that are in the market frequently and have a fairly stable credit base about which adequate information is available can be rated in a couple of hours. Ratings on first issue general obligation bonds and revenue issues take considerably longer. The entire analytical procedure may run a couple of days and include field trips and extended interviews.

Factors Considered in Rating General Obligation Bonds

Though the rating agencies do not divulge in detail the particular factors and weights used in assigning the individual ratings, it appears that the following basic quantitative data must be considered in the evaluation.

1. Current population of the community involved.
2. True, or market, taxable valuations.
3. Gross indebtedness.
4. Net indebtedness--debt after making deductions for self-sustaining obligations, sinking funds, state

assistance.

5. Overall, or combined indebtedness--net debt plus the proportionate share of the indebtedness of any other governmental unit for which the community is liable.
6. The ratio of combined debt expressed as a percentage to population.
7. The ratio of combined debt expressed as a percentage of true or market valuations.
8. The ratio of combined debt expressed as a percentage of per capita income.
9. The community's historical tax collections record, including levies, collections and delinquencies.[11]

Testimony presented to the Twentieth Century Fund Task Force indicated that there are probably three financial items which are most important in judging general obligation bond creditworthiness.

1. The ratio of tax to the assessed value of taxable real estate. In most states, the amount of allowable debt is expressed as a percentage of the assessed value of taxable realty. Thus, this ratio can be used as an indication of the unused debt capacity.
2. Debt per capita. The level of net overall debt per capita is determined by dividing total outstanding tax-supported debt by population. In earlier years,

the dividing line between better and lesser credits was reported at about $200 for cities under 25,000; $250 for cities between 25,000 and 250,000; and $300 for cities over 250,000. Generally per capita debt levels of $100 to $150 above these are considered to be problems deserving careful examination.[12]

3. Annual debt service payments as a percentage of the total current-revenue budget expenditures. This ratio measures the weight of the current payment of principal and interest in the current-revenue budget, which excludes borrowing proceeds and disbursements of bond proceeds. While this method has several handicaps, a ratio of 10 percent is felt to be the separation between better and lesser creditworthiness, 15 percent warrants concern, and it should never exceed 20 to 25 percent.[13]

Other items in the general obligation analysis which various authors have offered as possible considerations in the ratings game are the percentage of outstanding debt repaid last year (less than 5 percent may be criticized); the percentage of capital outlays funded by current revenues (the higher, the better); tax collections seen as a percentage of assessments (these should be greater than 95 percent and ideally even out at 100 percent); overall tax rates on property by all overlapping local units (to

exceed $4 per $100 true value is considered high); and current deficits and short-term indebtedness.[14]

In addition to the aforementioned financial and debt data, the analyst also considers numerous economic and social factors in rating the bond issue of a municipality. Some of these factors which the Twentieth Century Fund Task Force on Municipal Bond Ratings suggested are as follows:

> Is it a one industry community? Is there diversification in industry? Is there a heavy dependence on extractive industry? What is the leading source(s) of income? What is the percentage of industry contribution to the tax base?
>
> Is the community a resort area, subject to wide economic swings? What are the value of its homes, its income levels, relative wealth, personal savings? Is the community the location of a major shopping center and related commercial activities?
>
> What are the educational attainments of the community? What percentage of its homes are owner-occupied? Is there evidence of civic pride, of active community programs for recreation and cultural activities, etc.[15]

Using this compilation of data, the agency decides on a

rating for the municipal issue. Although these compiled data are sometimes referred to as the rating criteria, they are not. Nowhere have the agencies explicitly stated how they weigh the various determinants to come up with a decision on ratings. It is not known outside the rating agencies how they measure risk, for there is no prototype, no guide based upon either a theoretical model or upon empirical research and analysis.

Literature Review

The mystique surrounding bond ratings has resulted in empirical studies by outsiders. These studies can be classified into two groups based on the objective of the study. One group of studies was designed to test empirically the effect of a bond rating; the other group was designed to analyze the ratings by attempting to explain what they represent based on common characteristics of each rating class.

a. Empirical Studies of the Effect of a Bond Rating

One study conducted in 1961 entitled "The Impact of Tightening Credit on Municipal Capital Expenditures in the United States," by Charlotte DeMonte Phelps of Cowles Foundation for Research in Economics at Yale University, estimated a linear relationship between parameters including the bond rating and the net interest cost to the borrower. The results of this study indicate that the interest ratio varies inversely with the credit rating assigned to the bond. Thus, Phelps concluded that "investors

believe there are substantial differences between the risks on Aaa, Aa, A and Baa bonds and that the interest rates on bonds in each of these categories reflect the risk differential."[16]

Another study in this group conducted by Reuben Kessel of the University of Chicago entitled "A Study of the Effects of Competition in the Tax-Exempt Bond Market," indicates that the bond rating does affect the interest cost of the debt issue. Using the difference between the twenty-year reoffering yield of more than 9,000 bond issues between 1959 and 1967, and White's Yield of 100, Kessel found significant differences between the interest costs of the first three ratings classes.[17]

"Credit Ratings and the Market for General Obligation Municipal Bonds," conducted by Daniel Rubinfeld of the University of Michigan, developed a model of the market for municipal bonds. Using a form of regression analysis, Rubinfeld's study indicated an 80 basis point spread between bonds rated Aaa and Baa. Of the nine variables used in his model, the bond rating explained the largest amount of this spread. Rubinfeld concluded the "rating process is worthy of study because ratings are likely to affect borrowing costs."[18]

b. Empirical Studies Analyzing the Underlying Characteristics of the Various Rating Classes

Relatively few studies have been made attempting to predict the bond ratings based on municipal characteristics. However, several studies have been conducted attempting to predict

corporate bond ratings using various corporate characteristics.

Probably the first model developed to predict bond ratings was by James Horrigan. Using multiple linear regressions with various combinations of 15 financial ratios, Horrigan was able to predict correctly 58 percent of Moody's ratings during the period 1961-1964.[19]

A more recent study by Pinches and Mingo obtained results similar to those of Horrigan. With a sample of 180 bonds rated by Moody's as B or above, and using multiple discriminant analysis, Pinches and Mingo correctly predicted 65 percent of the bonds within one rating of the actual.[20]

A study conducted by Pogue and Soldofsky in 1969 produced impressive results. Using regression analysis with a dichotomous dependent variable representing the probability of group membership in one group of the pair (e.g., Aaa and Aa, and Aa and A, etc.), Pogue and Soldofsky were able to predict 8 out of 10 bonds in the holdout sample.[21]

In 1970, the Federal Deposit Insurance Corporation commissioned Joseph J. Horton, Jr., a financial economist, to conduct a study to determine the differences, if any, between municipal bonds classified as investment quality bonds and those classified as noninvestment quality.[22] Bonds with a rating in one of the four highest ranks given by Moody's or Standard & Poor's are classified as investment quality. The FDIC was concerned as to

how bonds issued without a rating should be classified by the banks. At the time of this study, it was estimated that of the 92,000 governmental debt issues, only 20,000 issues had been rated. Although there is no authoritative standard of quality for these 72,000 issues of debt, bank examiners and security analysts must determine into which category these unrated bonds must be placed. For financial reporting purposes, noninvestment quality bonds are appraised at current market value whereas those of bank investment quality may be reported at the lower of book value or amortized cost. With banks holding approximately 40 percent of the outstanding state and local securities, this classification of the large number of unrated bonds posed a particularly difficult problem for the banking community.

Using regression analysis and several variables from a random sample of 100 general obligation municipal bonds which had been rates by Moody's, Horton developed a total of 14 models. The model which performed the best was as follows:

$$y = -1.25 - .15X_1 + .24X_2 + .12X_3 - .22X_4 + .29X_5$$

where,

y = a quality index number

X_1 = ratio of debt to assessed value

X_2 = log population

X_3 = tax collection rate

X_4 = "poorer states"

X_5 = "better states"

Using a holdout sample of 50 bonds (25 of investment quality and 25 of noninvestment quality), the developed model was able to predict correctly 88 percent of the noninvestment bonds and 72 percent of the investment quality bonds. Horton was pleased with the predictive ability of the model, especially since the information required (variables) in the model would be available for almost all municipalities. Bank examiners could use the equation with little difficulty.

In analyzing the ratings of the bonds in the sample, Horton noted that the bonds of municipalities located in the Southeast appeared to receive lower ratings than those of other areas which were similar in terms of the other variables used in his study. Horton states that this difference may be a marketability factor which simply "reflects the preferences of bond buyers," or it may be a "proxy for complex economic, social, historical, and demographic factors not included among the variables tested."[23] The group of states composed of Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Minnesota comprised one variable which Horton termed "poorer states." A second group composed of Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, Wisconsin, Michigan, Ohio, Illinois, Indiana, and New Jersey comprised a second group termed "better states."

In an estimating equation using only population and the variables "poorer states" and "better states," Horton was able to

predict correctly 88 percent of the bonds in the noninvestment holdout sample and 60 percent of the bonds in the investment category. Horton concludes that the success of this equation which includes no financial variables is indicative of "hidden financial factors which are highly correlated with location and population." Even so, the obvious void which is ignored in his study is how to deal with the municipal issues of the other twenty-six states--those states which do not fall within the group classified as "poorer states" or "better states."

In 1968, the Federal Deposit Insurance Corporation commissioned another municipal bond study to be conducted by Willard T. Carleton, Amos Tuck School of Business Administration, Dartmouth College, and Eugene M. Lerner, Northwestern University. The purpose of this study was to provide some insights for bank officials into the structure of municipal bond ratings to assist in the classification of unrated bonds.[24]

On the basis of a conversation with bond analysts, Carleton and Lerner selected six variables on the basis of being "readily available and unambiguous." The variables were

1. debt divided by assessed valuation
2. debt divided by population
3. logarithm of population
4. logarithm of debt
5. current tax collection rate, and
6. school district, a dichotomous variable.

Using multiple discriminant analysis and a random sample of municipal bonds rated by Moody's in 1967 as Aaa, Aa, A, Baa, and Ba, the developed model was able to predict correctly 53 percent of the municipal bond issues.

Analysis of the somewhat less than impressive results indicated that the majority of the misclassifications occurred in the A and Baa ratings. Carleton and Lerner concluded that this high concentration of errors in these middle classes suggests that Moody's analysts are not able to "pull apart" the population of municipal bonds under the current rating system and using the traditional rating classes. More research in the area was suggested.[25]

This study differs from the aforementioned ones in several ways. First, the number of variables to be considered will be greatly expanded. Such variables as revenue per capita, debt retired divided by debt issues, and others which have been suggested but not empirically tested by financial analysts as useful determinants of a municipality's creditworthiness will be used. Second, the time period for determining the variables will be expanded. A frequent criticism of some of the earlier studies attempting to estimate corporate bond ratings was that the variables were based solely on the most recent financial statement data, when, in reality, more than one year's data should be considered in developing the model. In this study, two year's data will be utilized and the variables will thus be the average of the two most recent

year's financial data. Third, the time period of the study will cover a three-year period, rather than one year as in the previous studies. Fourth, data from the earlier time periods will be used to develop the model. The model will then be applied to the data from a subsequent time period to determine the true predictive ability of the developed model.

CHAPTER III

METHODOLOGY

Quantitative Factors Used in the Study

Although the rating agencies refuse to disclose the particular factors taken into account, various commentators have suggested, without empirically testing, those factors which should be considered by the rating agencies in judging creditworthiness. Testimony presented before a Subcommittee on Economic Progress of the Joint Economic Committee of Congress and before the Twentieth Century Fund Task Force also indicated factors which are hypothesized as being used in rating a municipal bond issue.

Table 3 lists the factors selected for analysis in this study. The general criteria for selection of the factors are (1) frequently hypothesized in the literature as being useful determinants of bond quality, and (2) quantitative in nature. Inclusion of qualitative type factors in the model to be developed may enhance its predictability. However, the primary focal point of this study is to determine how useful quantitative (accounting) type data are in rating municipal bonds. The quantitative type data used are financial ratios which may be determined from the financial statements of a municipality. For each ratio, the average is with respect to the two most recent financial reporting

TABLE 3

FINANCIAL RATIOS USED IN THE ANALYSIS

Average Debt Per Capita

Average Full Faith and Credit Debt Per Capita

Average Revenue Per Capita

Average Percentage of Federal and State Aid to Total Revenue

Average Percentage of Long-term Debt Retired to Long-term Debt Issued

Average Percentage of Total Debt to Assessed Value of Property

Average Percentage of Total Debt to Estimated Market Value of Property

Average Percentage of Uncollected Taxes

Average Percentage of Welfare Payments to Total Revenue

Average Percentage of Property Taxes to Total Taxes

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periods prior to the rating of the municipal bond issue.

Two of the ratios, average percentage of welfare payments to total revenue and average percentage of property taxes to total taxes, have not been cited in the literature as useful determinants of a bond rating. The rationale for including those factors is discussed in the following section with the description of the ratio. A brief description of each of the ratios follows.

a. Average Debt Per Capita

Debt per capita is computed by dividing total bonded debt by population. The bonded debt figure is composed of all long-term credit obligations of the city and its agencies, whether backed by the city's full faith and credit or non-guaranteed, and all interest-bearing short-term credit obligations. All judgments, mortgages, and revenue bonds, as well as general obligation bonds, notes, and interest-bearing warrants are included. Excluded from the debt figure are noninterest-bearing short-term obligations, interfund obligations, amounts owed in a trust or agency capacity, advances and contingent loans from other govermnents, and rights of individuals to benefits from city employee retirement funds.

b. Average Full Faith and Credit Debt Per Capita

Average full faith and credit debt per capita is determined by dividing full faith and credit debt by the population. Full faith and credit debt is long-term debt for which the credit of the municipality is unconditionally pledged. This includes debt

payable initially from specific taxes or nontax sources, but represents a liability payable from any other available resources if the pledged sources are insufficient.

c. Average Revenue Per Capita

Revenue per capita is computed by dividing total revenue by population. For this ratio, revenue is defined as all amounts of money received by a government from external sources, net of refunds and other correcting transactions, other than from issuance of debt, liquidation of investments, and agency and private trust transactions. Noncash transactions such as receipt of services, commodities, or other "receipts in kind" are also excluded.

d. Average Percentage of Federal and State Aid to Total Revenue

This ratio, computed by dividing total federal and state aid by total revenue, measures the level of intergovernmental revenue. Federal and state aid include all amounts received by the municipality directly from the federal government or the state government.

e. Average Percentage of Long-Term Debt Retired to Long-Term Debt Issued

Computed by dividing total long-term debt retired by long-term debt issued, this ratio indicates the increasing or decreasing use of long-term debt to finance municipal projects. Long-term

debt retired is the total par value of long-term debt obligations liquidated by repayment of exchange, including debt retired by refunding obligations. Long-term debt issued is the par value of long-term debt obligations incurred during the fiscal year, including funding and refunding obligations. Debt obligations authorized, but not actually issued during the fiscal period are not included.

f. Average Percentage of Total Debt to Assessed Value of Property

This ratio is determined by dividing total bonded debt, as defined previously in the section discussing average debt per capita, by the sum of real and personal assessed property valuation.

g. Average Percentage of Total Debt to Estimated Market Value of Property

This ratio is computed by dividing total bonded debt, as previously defined, by the estimated market value of the property. The estimated market value of the real and personal property is determined by dividing the assessed value of the property by the estimated percentage of the assessed value to the market value as given in Moody's Bond Guide.

h. Average Percentage of Uncollected Taxes

The success of a city in collecting the taxes assessed is one of the more frequently cited factors hypothesized as being considered in rating a bond issue. The percentage of uncollected taxes is computed by dividing total property taxes uncollected at the municipality's year end by total property taxes levied for the

year.

i. Average Percentage of Welfare Payments to Total Revenue

Use of the per capita factors without some consideration for the profile of the population can be misleading. Intuitively, it seems that a large percentage of elderly, underprivileged and handicapped should be a consideration in rating a debt issue. Since the factors to be used in this study are limited to quantitative accounting type factors which could be determined from the annual report of a municipality, utilization of population profile data is prohibited. However, the ratio of welfare payments to total revenue is being used as a surrogate for data on the population profile. This ratio indicates the drain on city finances caused by payments to the less productive members of the municipality.

The percentage of welfare payments to total revenue is computed by dividing cash assistance welfare payments by total revenue. Cash assistance welfare payments are composed of all payments paid directly to needy persons under the categorical programs Old Age Assistance, Aid to Families with Dependent Children, Aid to the Blind, and Aid to the Disabled. Revenue, used in the denominator, is defined in the section describing revenue per capita.

Average Percentage of Property Taxes to Total Taxes

In recent periods, taxpayers have resisted high property tax rates. The success of their efforts has indicated that a municipality

does not have an unlimited power to tax. Since property taxes are a primary source of revenue, the percentage of property taxes to total taxes was selected for inclusion purely on a speculative basis to determine if this factor possesses any discriminating ability among the rating classes.

The factor is computed by dividing property taxes by total taxes. Property taxes are defined as general property taxes relating to property as a whole, real and personal, tangible or intangible whether taxed at a single rate or at classified rates. Total taxes are composed of property taxes, sales and gross receipts taxes and miscellaneous taxes.

The data used to generate these quantitative factors are collected from a publication of the Department of Commerce entitled "U. S. Bureau of the Census City Government Finances," and Moody's Municipal Bond Ratings Manual.

The Dependent Variable -- Bond Rating Classes

As indicated in Chapter 1, Moody's rates more municipal bond issues than Standard & Poor's. Few issues are rated only by Standard & Poor's. Therefore, Moody's bond ratings have been selected as the dependent variable for the present study. In addition, since most of the empirical studies of corporate bond ratings have selected Moody's ratings as the dependent variable, selection of Moody's will allow the results of this study to be viewed in light

of the results of the corporate bond rating studies.

There is a very limited number of bonds rated as marginally speculative (Ba), very speculative (B and Caa), and default (Ca). Municipalities receiving the low rating prefer to take their chances in the market without a rating. Therefore, this study is limited to Moody's top four rating classes, Aaa through Baa.

The Data Base

The data base consists of most general obligation issues of municipalities rated in one of Moody's top four rating classes for which the aforementioned quantitative factors can be computed, for the period from 1976 through 1978. Since the quantitative factors cover the two immediate years prior to the rating of the issue, the ratio data will cover the time period 1974 through 1977.

Several characteristics of this sample of bond ratings should be noted.

(1) The time period is limited to the period beginning in 1976. One way of assessing the worth of this study is through the use of certain prediction tests. The highly publicized debt and liquidity problems of New York City in 1975 may have caused a shift in the emphasis of the quantitative factors considered in rating a bond issue. Thus, it appears that a model based on data subsequent to 1975 may be a better

predictor.

(2) Only general obligation bonds are included. General obligation bonds are secured by the issuer's pledge of its full faith, credit, and taxing power for payment of the bonds. Rating of revenue bonds and housing authority bonds requires substantially different analysis. Revenue bonds are rated by analyzing the revenue-producing ability of the underlying asset; housing authority bonds are backed by the federal government and carry an Aaa rating.

(3) Only municipalities with a population of 50,000 or over are included in the sample. The financial information published in the U. S. Bureau of the Census publication, the primary source of data for this study, is reported only for cities with a population of 50,000 or over.

(4) The bond issue of a municipality is included in the sample only once, regardless of the number of general obligation issues made during the time period. It appears that all of the general obligation issues of a governmental unit bear the same credit rating; therefore, only the first issue made by the municipality during the period examined is included.

Statistical Procedures

Multiple discriminant analysis (MDA) is the appropriate statistical technique for this study. MDA is a multivariate statistical tool used to classify an observation into one of several a priori groupings (bond ratings, in this case) based on a set of discriminating variables.

Discriminant analysis involves deriving the linear combination of the independent variables that will discriminate best between the a priori defined groups. This is achieved by maximizing the between-group variance relative to the within group variance; thus, differences within each ratings class are minimized and the among-ratings class differences are maximized. The linear equations take the following form:

$$D_1 = v_{11}X_1 + v_{12}X_2 + \ldots + v_{1j}X_j \ldots + v_{1n}X_n$$

$$D_2 = v_{21}X_1 + v_{12}X_2 + \ldots + v_{2j}X_j \ldots + v_{2n}X_n$$

$$\vdots$$

$$D_s = v_{s1}X1 + v_{s2}X_2 \quad \ldots + v_{sj}X_j \ldots + v_{2n}X_n$$

where:

D_1 = the ith discriminant function, where
i = 1,2...s, and s is the smaller of one less than the number of groups or number of variables.

v_{ij} = the discriminant coefficient or weight for the j^{th} factor in the i^{th} discriminant function

X_j = the j^{th} factor included in the discriminant model, where j = 1,2...n.

Discriminant functions are computed using the financial ratio data for all bond issues in the sample for the years 1976 and 1977. The functions which result will then be used to predict the actual rating of the bonds in the holdout sample. The holdout sample is comprised of all 1978 bond issues in the sample. By entering the quantitative factors for each municipality in the holdout sample into the discriminant functions, a discriminant score is calculated for each bond issue. Comparison of the discriminant score for each bond issue with the discriminant scores for the rating classes (D_s) provides the basis for assigning each bond issue into one of the four rating categories.

The efficiency of the discriminant functions is measured by dividing the number of bonds assigned their actual Moody's rating by the total number of bonds receiving that rating. This efficiency measure is the basis for evaluating the homogeneity of financial characteristics of the municipalities within each bond rating class and differences among the rating classes. Furthermore, the discriminant coefficients (v_{ij}) provide information on those quantita-

tive factors which are most significant in differentiating the four rating classes.

There are two basic assumptions of the MDA model: (1) multivariate normality of the distributions and (2) unknown (but equal) dispersion and covariance structures for the groups.[26] There is some question as to the presence of a multivariate normal distribution in each of the rating classes for the financial ratios analyzed. Several studies have shown that financial ratios may not be normally distributed.[27] These studies were, however, on a univariate basis and based on data from manufacturing firms. No studies on the statistical distribution of ratios based on data from municipalities have been made. Fortunately, the existence of the multivariate normal distribution is not critical to the success of the study. Cooley and Lohnes suggest that the existence or nonexistence of a multivariate normal distribution should cause little concern.[28] They state:

> If it is possible to work with large enough and representative enough samples, sizeable effects and contrasts that appear in data analyses will have compelling implications for behavioral theory and educational practice without the buttressing of propositions about the probabilities of null hypotheses. This strategy requires showing what the factors extracted from the predictor batteries can do to reduce the unexplained variances in socially significant criterion variables. Prediction on replication samples is protection against capitalization on chance. The hazards of overfitting in multivariate analysis are great. Although significance tests, when appropriate, can help to protect against

> reporting results that can never be replicated, we tend to treat our multivariate models as primarily heuristic rather than inferential procedures.[29]

The second basic assumption, equality of the variance-covariance matrices of the variables within each rating class, is required since linear equations are used for discriminating between groups. If the variance-covariance matrices of the independent variables are not equal, quadratic discriminant functions should be used. The effect of unequal variance-covariance matrices is that the efficiency with which the discriminant functions can correctly predict the bond ratings will be lower if linear rules are used instead of quadratic rules.[30] Since the MDA statistical packages available do not provide for quadratic discriminant functions, linear functions will be used and are assumed to be sufficient, realizing that the results are subject to a possible downward bias. Even if a problem does exist with the equality of the variance-covariance matrices, the heuristic aspects of the MDS results are of prime importance as suggested by Cooley and Lohnes.

The discriminant functions and related analysis will be done by the Multiple Discriminant Analysis Program in the Statistical Package for the Social Sciences (SPSS) program package. The stepwise method will be used to select from all the quantitative factors initially considered for inclusion in the model. The stepwise method involves entering the independent variables into

the discriminant function one at a time on the basis of their discriminating power. Eventually, either all independent variables will have been included in the function, or the excluded variables will have been judged as not contributing significantly toward further discrimination.

In determining which independent variables are to be considered for inclusion in the discriminant model, the partial multivariate F ratio is calculated. "The partial F ratio measures the discrimination introduced by the variables by taking into account the discrimination achieved by the other selected variables."[31] A minimum F ratio is set at 1.0, a level which insures that "almost any variable with discriminating power is chosen and retained for analysis."[32] The minimum F ratio does not insure the actual inclusion of a given ratio in the model. In the stepwise procedure, the criterion for actual inclusion is the "overall multivariate F ratio for the test of differences among group centroids."[33] Centroids are mean values of the discriminant scores for each rating category. The objective is to include those factors which maximize the separation of the industries and hence maximize the F ratio.

The factors which maximize the separation of the group centroids and the F ratio also minimize the Wilks' lambda statistic. Wilks' lambda is a measure of overall differentiation which considers the differences between all the centroids and the homogeneity within the groups.[34]

With the Wilks' lambda-multivariate F ratio as the selection criterion, the stepwise procedure begins by selecting the variable which has the highest value on the selection criterion.

> This initial variable is then paired with each of the other variables, one at a time, and the selection criterion is computed. The new variable which in conjunction with the initial variable produces the best criterion value is selected as the second variable to enter the model. This procedure of locating the next variable that would yield the best criterion, given the variables already selected, continues until all variables are selected or no additional variables provide a minimum level of improvement.[35]

Variables are added to the model as long as the partial F ratio equals or exceeds 1.0; if it does not, the process of adding variables stops. The discriminant coefficients are then derived for the variables included.

CHAPTER 4

THE RESULTS

The analysis sample consists of 152 bond issues from 39 states. The discriminant functions determined from the analysis sample were used to predict the ratings of 43 bond issues in 1978 from 26 states. A list of the municipalities included in the analysis sample and a comparison of the predicted group with their actual Moody's bond rating is given on Exhibit II in the appendix.

Univariate Analysis

The group means and standard deviations for each of the ten independent variables are shown in Table 4 and Table 5 respectively. Analysis of the univariate results indicates that five of the independent variables, revenue per capita, percentage of federal and state aid to total revenue, percentage of debt to market value of property, percentage of debt to assessed value of property and percentage of property tax to total tax, are significantly different for each of the rating groups at the 1 percent level. Further analysis of these results on a univariate basis shows that there is no consistent pattern of changes in the group means. For example, it would appear that debt per capita would be lowest for the Aaa group and would increase for each lower rating class. Intuitively, it seems

TABLE 4

GROUP MEANS

Variable	Bond Rating			
	Aaa	Aa	A	Baa
Debt per capita	501.01	523.38	470.33	624.51
Full faith and credit debt per capita	357.79	315.47	285.04	359.91
*Revenue per capita	496.22	377.86	363.35	595.04
*Percentage of federal and state aid to total revenue	.333	.314	.313	.440
Percentage of long-term debt retired to long-term debt issued	2.784	1.204	1.288	.745
*Percentage of total debt to assessed value of property	.066	.111	.152	.207
*Percentage of total debt to market value of property	.039	.042	.051	.090
Percentage of uncollected taxes	.038	.054	.089	.077
Percentage of welfare payments to total revenue	.010	.019	.012	.016
*Percentage of property taxes to total taxes	.891	.607	.650	.799

*Univariate F Ratio indicates that these variables are significantly different at .01

TABLE 5

GROUP STANDARD DEVIATIONS

Variable	Bond Rating			
	Aaa	Aa	A	Baa
Debt per capita	304.41	292.11	253.74	248.07
Full faith and credit debt per capita	219.54	221.50	189.68	205.88
Revenue per capita	333.94	190.18	174.91	229.23
Percentage of federal and state aid to total revenue	.3334	.1902	.1749	.2292
Percentage of long-term debt retired to long-term debt issued	9.5357	2.0648	1.6863	.9623
Percentage of total debt to assessed value of property	.0450	.0810	.1881	.1021
Percentage of total debt to market value of property	.0254	.0236	.0307	.0305
Percentage of uncollected taxes	.030	.237	.208	.034
Percentage of welfare payments to total revenue	.024	.040	.029	.023
Percentage of property taxes to total taxes	.127	.268	.263	.231

that the higher the average debt per capita, the greater the chance of default and thus the lower the rating. This is not the case. Debt per capita is lowest for the municipalities with A rated bonds. Similar inconsistencies can be noted with revenue per capita. It would appear that the higher the revenue per capita, the greater the wealth of the municipality, and the less chance of default. The more income available in the community, the more able it should be to meet its maturing obligations. Thus, revenue per capita should be highest for municipalities with Aaa rated bonds. In fact, revenue per capita is highest for the municipalities with Baa bonds, then Aaa's, then Aa's, and finally, A's. As can be noted from Table 4, similar inconsistencies exist for some of the other independent variables. Two variables, percentage of total debt to assessed value of property and percentage of total debt to estimated market value, are ordered in a consistent manner.

Multivariate Analysis

The univariate analysis does not investigate the interdependence among the variables. As a result, multivariate analysis was performed. Using data from 1976 and 1977 and the stepwise selection method, three discriminant functions (one less than the number of groups) were generated. The stepwise method begins by selecting the single best discriminating variable. The initial variable is then paired with each of the other independent variables one at a

time, and a second variable is selected. The second variable is the one which is best able to improve the discriminating power of the function in combination with the first variable. Eventually, all the variables will have been included in the function or the excluded variables will have been judged as not contributing significantly toward further discrimination. The order of the eight variables selected for inclusion in the model is shown on Table 6. As indicated by the change in the Wilks' lambda, the first three variables to enter the model possess the most discriminatory power.

It is logical that the percentage of debt to market value of the property was determined to be the most discriminating variable. This ratio estimates the amount of property required to liquidate the debt of the municipality. Therefore, it is intuitive that the higher the percentage, the lower the bond rating. Recall that on a univariate basis, this variable was ordered in a consistent manner and the F ratio indicated significant difference at the 1 percent level.

Debt per capita entered the model at step two as the second most discriminating variable when considered in connection with the percent of debt to market value of the property. This frequently cited measure of municipality's ability to pay its obligations is apparently useful to Moody's in assessing creditworthiness. It is reasonable that the amount of debt burden shared by each individual

TABLE 6

ORDER OF DISCRIMINATING VARIABLES
ENTERED IN THE MODEL

Step	Variable Entered	Wilks' Lambda
1	Percent of debt to market value of property	.7921
2	Debt per capita	.5924
3	Percent of property tax to total taxes	.4878
4	Revenue per capita	.4700
5	Percent of debt to assessed value of property	.4558
6	Percent of welfare payments to total revenue	.4418
7	Percent of uncollected taxes	.4283
8	Percent of federal and state aid to total revenue	.4178

within the municipality would possess discriminatory power among the rating classes.

The third variable to be selected for inclusion in the model, percentage of property tax to total taxes, indicates how heavily the governmental units rely on property tax as a source of revenue. Prior to the Depression, property tax receipts accounted for approximately two-thirds of all general revenues of state and local governments. Many municipalities relied entirely on the property tax with other sources of revenue of little importance.[36] Property tax has a low income elasticity. That is, as the income level of the unit increases, the increase in the tax revenue for the municipality is not proportional. In times of inflation, municipalities with a heavy reliance on property taxes as a source of revenue would face tight financial situations. Thus, this ratio is an indication of the ability of the city to keep up with operating costs in periods of rising prices. It is intuitive that this variable should be considered in assessing the creditworthiness of a governmental unit.

The other five variables to enter the model in steps four through eight possess approximately the same amount of discriminatory power among the rating classes. It appears reasonable that these variables were included and do possess discriminatory power among the classes.

The standardized and unstandardized discriminant function coefficients for the eight independent variables included in the model are shown in Table 7. These discriminant functions maximize the separation between the groups of ratings. It is interesting to note that the model includes three variables, debt per capita, percentage of uncollected taxes, and percentage of welfare payments to revenue, which were not significantly different for each rating group on a univariate approach. This is caused by the interaction among the variables. These three variables are significant when considered in connection with the other variables included in the discriminant model.

The unstandardized coefficients measure the contribution of each variable to the total discriminant score, but these coefficients do not report the relative importance of the variables. The standardized coefficients are obtained by multiplying each unstandardized coefficient by its standard deviation.[37] The standardized discriminant function coefficients are of great analytic importance. When the sign is ignored, each coefficient represents the relative contribution of its associated variable to that function. The sign merely denotes whether the variable is making a positive or negative contribution.[38]

The results indicate that for function 1, which discriminates between Aaa and Aa rated bonds, the percentage of debt to market

TABLE 7

STANDARDIZED AND UNSTANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS

Variables included in the Model	Function 1		Function 2		Function 3	
	Stan-dardized	Unstan-dardized	Stan-dardized	Unstan-dardized	Stan-dardized	Unstan-dardized
Debt per capita	1.632	5.877	-0.141	-0.505	-0.699	-2.517
Revenue per capita	-0.040	-0.179	-0.563	-2.519	-0.183	-0.824
Percentage of federal and state aid to total revenue	.158	1.199	-0.177	-1.345	-0.531	-4.034
Percentage of welfare payments to revenue	-0.071	-2.203	0.441	13.586	-0.028	-0.874
Debt to market value of property	-1.802	-66.159	0.029	1.056	0.019	0.695
Debt to assessed value of property	-0.293	-2.286	0.193	1.510	0.460	3.590
Percentage of uncollected taxes	-0.155	-1.051	0.272	1.850	0.215	1.460
Percentage of property taxes to total taxes	.177	.483	-0.664	-2.742	0.548	2.262

value of the property and debt per capita are the most important discriminating variables. In fact, these two variables are approximately three times as important as the other six variables combined. For function 2, which discriminates between Aa and A rated bonds, these same two variables contribute very little to the model's discriminatory power. The percentage of property tax to total tax followed by revenue per capita are the most discriminating variables for function 2. For function 3, which discriminates between A and Baa rated bonds, the standardized discriminant coefficients indicate that debt per capita and average property tax to total tax, respectively, make the largest contribution to the model's discriminating power. It is interesting that the percentage of debt to market value of the property is the most discriminating variable in function 1, and the least discriminating variable in both functions 2 and 3. This shift is caused by the change in the linear combination of the variables selected when the first function was determined.

The functions are derived in the order of discriminating power. Each function derived after the initial function has less discriminating power than the previous one. When a large number of functions are generated, some of the later ones can be ignored since they possess little or no discriminating power. In order to determine the relative ability of each function to discriminate

between the rating classes, eigenvalues for each function were computed. The eigenvalue is a measure of the relative importance of the function. The sum of the eigenvalues is a measure of the total variance existing in the discriminating variables. When a single eigenvalue is expressed as a percentage of the total sum of eigenvalues, the result is a reference of the relative importance of the associated function. The eigenvalues and the relative percentage discrimination attributable to each function are shown in Table 8. Analysis of Table 8 indicates that function 3 contributes little to the discriminating power.

To test whether all three discriminant functions are statistically significant and should be used in the analysis, Wilks' lambdas and their associated chi-square tests of significance were generated. The results are shown in Table 9. Before any functions were determined, Wilks' lambda was .41775. This indicates that considerable discriminating power exists in the variables being used. The larger the lambda value, the less discriminating power is present. After some of this discriminating power has been removed by placing some of the variables in the first function, lambda increases to .72022, but the chi-square indicates that a statistically significant amount of discriminating information still exists. After additional discriminating power has been removed by placing it in the second function, a large lambda (.95159) is found. Although the third function does not add a tremendous amount to

TABLE 8

EIGENVALUES FOR EACH DISCRIMINANT FUNCTION

Discriminant Function	Eigenvalues	Relative Percentage Discrimination Attributable to Each Function
1	.724	66.05
2	.321	29.31
3	.051	4.64

TABLE 9

WILKS' LAMBDA AND CHI-SQUARE RESULTS

Discriminant Function	Wilks' Lambda	Chi Square	Degree of Freedom	Significance
0	.41775	126.56	24	.0000
1	.72022	47.59	14	.0000
2	.95159	7.19	6	.3032

the discriminating ability, the function adds a sufficient amount to include it in the analysis of the predictability of the model.

The primary purpose of this study is to determine how well a municipal bond rating could be predicted using quantitative accounting-type data. The functions developed with data from 1976 and 1977 were used to predict Moody's bond rating for 43 municipal bond issues in 1978. The results are reported in Table 10. The prediction results are informative in that these variables are more effective in predicting the rating than previous discriminant analysis studies in the area. For example, Carleton and Lerner achieved 53 percent classification accuracy. The 67.44 percent classification accuracy is less impressive when compared to the results of corporate bond rating studies. However, with financial ratios based on data prepared in accordance with generally accepted accounting principles, more accuracy in predicting the rating of a corporate bond would be expected.

The misclassifications are greatest in the Aa group. Only 57.9 percent of these are accurately predicted with 21.1 percent predicted as Aaa. The greatest accuracy in predicting the ratings is in the Aaa group. Eight of the nine bond issues in 1978 that received a prime rating were correctly predicted. If the predictors' tolerance for errors will accept errors within one rating, the discriminant functions will produce very satisfactory results.

TABLE 10

RESULTS OF PREDICTION OF 1978 BOND RATINGS

Actual Bond Rating	No. of Cases	Aaa	Aa	A	Baa
Aaa	9	8	-	1	-
		88.8%		11.1%	
Aa	19	4	11	2	2
		21.1%	57.09%	10.5%	10.5%
A	9	-	2	6	1
			22.2%	67.7%	11.1%
Baa	6			2	4
				33.3%	66.7%

Percent of Bonds Correctly Rated: 67.44%

Within one rating class, the 1978 municipal bond issues were predicted with 93 percent accuracy.

Several authors have suggested that the bonds of large municipalities are rated using different criteria from those used with middle-size and small municipalities. To determine whether exclusion of the larger municipalities included in this study would enhance the predictability of the developed model, discriminant analysis was performed excluding the larger municipalities. The predictive accuracy of the resulting model first excluding municipalities with populations over 500,000, then excluding municipalities with populations over 650,000, and finally excluding municipalities with populations over 800,000, is reported in Table 11. The results indicate that exclusion of the large municipalities does not enhance the predictability of the model, but in fact, it decreases the percent correctly classified. Inclusion of all the municipalities in the development of a general model applicable to municipalities regardless of size appears most logical.

TABLE 11

PERCENTAGE OF 1978 BOND ISSUES CORRECTLY RATED WHEN LARGE MUNICIPALITIES ARE EXCLUDED

	Excluding municipalities with a population of more than		
	500,000	650,000	800,000
Percent correctly rated	62.50	65.85	66.67
Number in analysis sample	138	145	148
Number in prediction sample	40	41	42

CHAPTER V

CONCLUSIONS

The prediction accuracy reported in Chapter IV indicates that accounting data is useful in evaluating the creditworthiness of a municipality. In addition, these results suggest the following three possibilities. First, there may be an increasing emphasis on quantitative factors in rating municipal bonds. Second, there may be additional quantitative factors which municipal finance officers should consider when attempting to upgrade the rating of their city's bonds. Third, disclosure of certain of the variables considered in this study may be useful to readers of municipal government annual reports.

Increasing Emphasis on Quantitative Factors

Compared to a previous study with a similar methodology conducted by Carleton and Lerner in 1967, the results of this study are more successful in terms of prediction accuracy. This increase in predictability may have resulted from utilization of different variables in the two studies. Although this study considered several variables not included in the previous study, there are three variables which were common to both studies, debt per capita, percentage of debt to assessed value of property and percentage of uncollected

taxes. In both studies, these three variables were determined to possess discriminating power among the four bond rating classes. On the other hand, this observed increase in prediction accuracy could be the result of an increased emphasis on quantitative, accounting-type data by the rating agency. Since the much publicized New York problem of 1975, the rating agencies may have shifted their emphasis to more quantitative-type factors. In the event that the agency would be publicly questioned by investors to substantiate the rating of a municipality's bond, quantitative-type factors would be more easily explained and understood than qualitative-type factors. The publicity given municipalities (New York and Cleveland) in recent years may have resulted in more consideration being placed on more objective data. Although this study is not structured to test for a shift in emphasis by the rating agency, the results do indicate this as a possibility.

Factors to Focus on in Upgrading a Municipality's Bond Rating

A basic criterion for selecting eight of the ten ratios used in this study was that the factor was frequently cited in the literature as being a useful determinant of a municipal bond rating. Six of the ratios selected on that basis did prove to be useful in discriminating among the rating classes. The other two factors, average percentage of long-term debt retired to long-term debt issued and average full faith and credit debt per capita, were excluded from the

discriminant model. Thus, it appears that municipal finance officers who wish to improve the ratings of their city need not focus their attention on these two factors.

It is intuitive that these two ratios should not be included in a model for general application to all cities. Clearly, a rapidly expanding municipality, such as Houston, may issue more bonds during this growth period, than bonds retired. This would not necessarily be a sign of financial strain. On the other hand, issuance of more debt than debt retired may indicate financial problems for a municipality such as Cleveland. This excluded factor may raise the rating of some cities and lower the rating for others. Exclusion of the other factor, average full faith and credit debt per capita, is also intuitive. Debt per capita, which includes all long-term and short-term credit obligations, possesses discriminating power. Thus, the rating agency considers all debt of the municipality, whether backed by the city's full faith and credit or nonguaranteed.

Two factors included in the analysis which have not been frequently cited as useful determinants of a municipality's creditworthiness were average percentage of welfare payments to total revenue, and average percentage of property taxes to total taxes. Both factors were determined to possess discriminatory power. As shown in Table 6 in Chapter IV, the average percentage of property tax to total taxes was the third variable to enter the model using

the stepwise procedure; the average percentage of welfare payments to total revenue was the sixth variable selected. Therefore, municipal officials who wish to improve the bond rating of their municipality should direct their attention to these two factors as well as those that are frequently cited.

Disclosure in Annual Reports

With this apparent usefulness of accounting data in assessing the creditworthiness of a municipality, the profession should consider disclosure of some or all of these variables in the annual report of a municipality. Much has been written on the difficulty of evaluating the performance of a municipality. Lengthy, involved annual reports and cumbersome accounting procedures are often cited as problems which the financial statement readers face. As the profession considers changes in the reporting practices of municipalities to deal with these and other complaints of governmental reports, consideration should be given to disclosure of these concise measures which have been accepted to some extent in the financial community as useful determinants in rating a municipality's bond issue.

Limitations

Several limitations in this study should be noted. The basic assumptions of the Multiple Discriminant Analysis procedures as discussed in Chapter III may not be met, but were assumed for this

study. Furthermore, the results are applicable only to cities with populations in excess of 50,000.

Although the results of this study have indicated some interesting points, exact duplication of Moody's bond ratings using only the selected variables was not obtained. Other accounting information type variables may also contain discriminatory power and their inclusion may have improved the predictive ability of the functions. Future experimentation with more variables, quantitative and qualitative, and with non-linear discriminant functions needs to be done.

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9. "The Men Who Make Treasures Tremble," Forbes (September 1, 1970): p. 19.

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EXHIBIT I

KEY TO MOODY'S BOND RATINGS

Aaa

Bonds which are rated Aaa are judged to be of the best quality. They carry the smallest degree of investment risk and are generally referred to as "gilt edge." Interest payments are protected by a large or by an exceptionally stable margin and principal is secure. While the various protective elements are likely to change, such changes as can be visualized are most unlikely to impair the fundamentally strong position of such issues.

Aa

Bonds which are rated Aa are judged to be of high quality by all standards. Together with the Aaa group they comprise what are generally known as high grade bonds. They are rated lower than the best bonds because margins of protection may not be as large as in Aaa securities or fluctuation of protective elements may be of greater amplitude or there may be other elements present which make the long-term risks appear somewhat larger than in Aaa securities.

A

Bonds which are rated A possess many favorable investment attributes and are to be considered as upper medium grade obligations. Factors giving security to principal and interest are considered adequate but elements may be present which suggest a susceptibility to impairment sometime in the future.

Baa

Bonds which are rated as Baa are considered as medium grade obligations, i.e., they are neither highly protected nor poorly secured. Interest payments and principal security appear adequate for the present but certain protective elements may be lacking or may be characteristically unreliable over any great length of time. Such bonds lack outstanding investment characteristics and in fact have speculative characteristics as well.

EXHIBIT I
(continued)

KEY TO MOODY'S BOND RATINGS

Ba

Bonds which are rated Ba are judged to have speculative elements; their future cannot be considered as well secured. Often the protection of interest and principal payments may be very moderate and thereby not well safeguarded during both good and bad times over the future. Uncertainty of position characterizes bonds in this class.

B

Bonds which are rated B generally lack characteristics of the desirable investment. Assurance of interest and principal payments or of maintenance of other terms of the contract over any long period of time may be small.

Caa

Bonds which are rated Caa represent obligations which are in poor standing. Such issues may be in default or there may be present elements of danger with respect to principal or interest.

Ca

Bonds which are rated Ca represent obligations which are speculative in a high degree. Such issues are often in default or have other marked shortcomings.

C

Bonds which are rated C are the lowest rated class of bonds and issues so rated can be regarded as having extremely poor prospects of ever attaining any real investment standing.

General Note: Those bonds in the A and Baa groups which Moody's believes possess the strongest investment attributes are designated by the symbols A-1 and Baa-1. Other A and Baa bonds comprise the balance of their respective groups.

Source: Moody's Municipal & Governmental Manual.

EXHIBIT II

LIST OF MUNICIPALITIES INCLUDED IN THE ANALYSIS SAMPLE

AND THE PREDICTIVE GROUP

Part A. Municipalities in the Analysis Sample

State/Municipality	Moody's Bond Rating
Alabama	
Birmingham	A
Gadsden	A
Mobile	A
Arizona	
Phoenix	Aa
Scottsdale	A
Tempe	A
Tucson	A
Arkansas	
Little Rock	A
California	
Orange	A
Colorado	
Colorado Springs	Aa
Denver	Aa
Fort Collins	Aa
Connecticut	
Bristol	A
East Hartford Town	Aa
Fairfield	Aaa
Hartford	Aaa
Meriden	A
New Bedford	Aaa
Norwalk	Aa
Stamford	Aaa
Waterbury	Baa

EXHIBIT II

Part A. Municipalities in the Analysis Sample (continued)

State/Municipality	Moody's Bond Rating
Delaware	
Wilmington	A
Florida	
Jacksonville	A
Miami	A
St. Petersburg	A
West Palm Beach	A
Georgia	
Atlanta	Aa
Macon	A
Savannah	Aa
Illinois	
Des Plaines	Aa
Evanston	Aaa
Joilet	A
Oak Lawn	A
Iowa	
Council Bluffs	Aa
Davenport	Aaa
Des Moines	Aaa
Dubuque	Aaa
Sioux City	Aaa
Waterloo	Aa
Kansas	
Topeka	Aa
Wichita	Aa
Kentucky	
Louisville	A

EXHIBIT II

Part A. Municipalities in the Analysis Sample
(continued)

State/Municipality	Moody's Bond Rating
Louisiana	
Lafayette	A
New Orleans	A
Maine	
Portland	Aaa
Massachusetts	
Boston	Baa
Brockton	Aaa
Fall River	A
Lowell	Baa
Malden	A
Newton	Aaa
Springfield	Aa
Waltham	Aa
Michigan	
Detroit	Baa
Grand Rapids	Aa
Livonia	A
Roseville	Baa
Southfield	Aa
Sterling Heights	A
Minnesota	
Bloomington	Aa
Duluth	Aa
Minneapolis	Aaa
Rochester	Aaa
St. Paul	Aa
Mississippi	
Jackson	Aa

EXHIBIT II

Part A. Municipalities in the Analysis Sample (continued)

State/Municipality	Moody's Bond Rating
Missouri	
Kansas City	Aa
St. Louis	A
Springfield	A
Nebraska	
Omaha	Aaa
Nevada	
Reno	A
New Jersey	
Bloomfield	Aaa
Camden	Baa
Cherry Hill	A
Dover Township	A
Elizabeth	A
Jersey City	A
Paterson	Baa
Trenton	A
Union Township	Aa
Woodbridge Township	Aa
New Mexico	
Albuquerque	A
New York	
Albany	Baa
Buffalo	Baa
New Rochelle	A
Niagra Falls	Baa
Rochester	Aaa
Schenedtady	Aaa
Syracuse	Aa
Troy	Baa
Utica	A

EXHIBIT II

Part A. Municipalities in the Analysis Sample (continued)

State/Municipality	Moody's Bond Rating
North Carolina	
Asheville	A
Charlotte	Aaa
Durham	Aa
Fayetteville	A
Raleigh	Aaa
Winston-Salem	Aa
North Dakota	
Fargo	Aa
Ohio	
Akron	Aa
Columbus	Aa
Cincinnati	Aa
Dayton	Aa
Cleveland Heights	Aa
Toledo	Aa
Youngstown	A
Oklahoma	
Tulsa	Aa
Oregon	
Portland	Aaa
Salem	Aaa
Pennsylvania	
Abington Township	Aa
Lower Merion Township	Aaa
Philadelphia	Baa
Pittsburgh	A
Rhode Island	
Pawtucket	Aa

EXHIBIT II

Part A. Municipalities in the Analysis Sample (continued)

State/Municipality	Moody's Bond Rating
South Carolina	
Charleston	A
Greenville	Aa
Tennessee	
Chattanooga	Aa
Knoxville	A
Memphis	A
Texas	
Arlington	Baa
Austin	Aaa
Corpus Christi	Aa
Dallas	Aaa
Fort Worth	Aa
Grand Prairie	A
Irving	Aa
Lubbock	Aa
Mesquite	A
Midland	Aa
Pasadena	A
Utah	
Provo	Aa
Salt Lake City	Aaa
Virginia	
Alexandria	Aa
Arlington Heights	Aa
Chesapeake	Aa
Hampton	A
Lynchburg	Aa
Manchester	A
Norfolk	Aa
Richmond	Aa
Roanoke	Aa
Virginia Beach	Aa

EXHIBIT II

Part A. Municipalities in the Analysis Sample (continued)

Washington	
Seattle	Aa
Tacoma	A
Wisconsin	
Appleton	A
Kenosha	Aa
Madison	Aaa
Milwaukee	Aaa
Oshkosh	Aa
Portsmouth	A
Racine	A
Wauwatosa	Aaa
West Allis	A

Part B. Municipalities in the Prediction Group

State/Municipality	Moody's Bond Rating
Arizona	
Glendale	Aa
California	
Orange	A
Connecticut	
New Britain	A
West Haven	Aaa
Florida	
Gainesville	Aaa
Georgia	
Augusta	Aa

EXHIBIT II

Part B. Municipalities in the Prediction Group

Illinois	
Arlington Heights	Aa
Elgin	Aa
Peoria	Aa
Rockford	Aa
Iowa	
Cedar Rapids	Aaa
Maryland	
Baltimore	A
Massachusetts	
Cambridge	Aa
Lynn	Baa
Quincy	Aa
Sommerville	Baa
Michigan	
Taylor	A
Missouri	
Independence	Aa
St. Joseph	Aa
Nebraska	
Lincoln	Aaa
New Jersey	
Union City	Baa
New York	
Yonkers	Aa

EXHIBIT II

Part B. Municipalities in the Prediction Group

State/Municipality	Moody's Bond Rating
North Carolina	
Greensboro	A
High Point	Aa
Ohio	
Lakewood	Aa
Lorain	Baa
Salem	Aaa
Oklahoma	
Lawton	A
Oregon	
Eugene	Aaa
Pennsylvania	
Scranton	A
Rhode Island	
Providence	A
Texas	
Beaumont	A
Garland	Aa
Tyler	A
Waco	A
Utah	
Ogden	Aaa
Virginia	
Newport News	Aa

EXHIBIT II

Washington	
Bellevue	A
Spokane	Aaa
West Virginia	
Charleston	Aa
Huntington	Aa
Wisconsin	
Oshkosh	Aa

VITA

Kenneth Edward Peacock was born in Rocky Mount, North Carolina on June 20, 1948. His undergraduate studies in accounting were completed at Mars Hill College in May 1970, when he received his Bachelor of Science degree. Following graduation, Mr. Peacock joined the international public accounting firm, Price Waterhouse & Co. From 1970 to 1975, he worked in Winston-Salem, North Carolina office of the certified public accounting firm as a senior tax accountant.

In August 1975, Mr. Peacock resigned from Price Waterhouse & Co. and began his graduate studies at Louisiana State University in Baton Rouge. He was awarded his Master of Science degree in Accounting in August 1977, and will be awarded the Doctor of Philosophy degree in Accounting in December 1979.

In 1977, the author received the Exxon Award, given by the faculty to one graduate student for outstanding achievements in graduate work. In 1978, the students voted to award him the Lloyd F. Morrison Award for outstanding teaching. In addition, he received a $3,500 Doctoral Fellowship granted by Delliott, Haskins & Sells, an international public accounting firm, and was later appointed to represent the University at the American Accounting Association Doctoral Consortium in Denver, Colorado. He is a

member of several professional societies and community-service organizations.

In January 1980, Mr. Peacock will join the faculty of the McIntire School of Commerce at the University of Virginia at Charlottesville. As an Assistant Professor of Commerce, he will teach undergraduate and graduate courses in taxation.

Mr. Peacock is married to the former M. Rosanne Barkley of Winston-Salem. They have one son, Christopher Edward.